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Mixing Zones

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ENVIRONMENTAL PROTECTION AGENCY
Office of Water Programs

MIXING ZONES

Division of Water Quality Standards
Washington, D. C.
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INTRODUCTION

This is a report prepared by the Water Quality Standards Division, Environmental Protection Agency, an independent regulatory agency which has responsibility for approving State-adopted standards, evaluating adherence to the standards, and overseeing enforcement of standards compliance.

Standards, the first nationwide strategy for water quality management, contain four major elements: the use (recreation, drinking water, fish and wildlife propagation, industrial, or agricultural) to be made of the interstate water; criteria to protect those uses; implementation plans (for needed industrial-municipal waste treatment improvements) and enforcement plans; and an antidegradation statement to protect existing high quality waters.

Minimum water quality criteria, or numerical specifications of physical, chemical, temperature, and biological levels, are stated in the National Technical Advisory Committee report to the Secretary of the Interior, Water Quality Criteria, dated April 1, 1968, published by the Government Printing Office, Washington, D.C. Unavailability of the NTAC report before June 30, 1967--the date set by the Water Quality Act of 1965 for formal adoption of State standards--resulted in significant variations between the State-adopted and the NTAC minimum criteria. Some standards were adopted and approved before the NTAC report became available.

The Water Quality Criteria report is presently being updated in light of new scientific and technical information, with scheduled publication in June, 1972. These criteria compilations are issued to provide information to the public on water quality standards. As further information becomes available, they will be updated.

Water quality standards are subject to change when justified by newly available technical and scientific information. For the latest information refer to the existing approved water quality standards which can be obtained from the individual State water pollution control agency or EPA regional office.

Mixing zones are areas which are unavoidably and harmfully polluted and which are allowed for mixing of the discharged waters with the receiving waters. They have defined and identifiable limits, and the waters outside of the zones must meet the standards for that particular body of water. The Water Quality Criteria report recommends when several mixing zones are located close together that they lie on the same side of the stream to allow a continuous passageway for aquatic organisms on the opposite side. The NTAC report specifies that mixing zones be as small as possible and provided only for mixing in order to preserve the "welfare of the aquatic life resource." This is because mixing zones constitute barriers which can harmfully block the spawning migration of anadromous and catadromous species and damage the plankton organisms and aquatic invertebrates in the water flow. Adequate zones of passage (at least 75% of the cross-sectional stream area, according to NTAC) must be maintained at all times for the fish, and adequate provision must be made for the survival of the drift organisms. Mixing zones cannot be considered a substitute for, or an extension of a waste treatment facility. The EPA supports the NTAC recommendations.

Individual state-adopted standards follow.

SUMMARY OF MIXING ZONE STANDARDS

Alabama	-The ambient temperature of receiving water in degrees Fahrenheit, after reasonable mixing shall not be increased by more than 10 percent by the addition of domestic, industrial or other wastes nor shall this waste cause the temperature of the receiving waters to exceed 90°F for not more than eight hours during any twenty-four hour period.
Alaska	No reference to mixing zones.
Arizona	No reference to mixing zones.
Arkansas	No reference to mixing zones.
California	No reference to mixing zones.
Colorado	No reference to mixing zones.
Connecticut	-Connecticut's General Policy statement concerning <u>Water Quality Criteria</u> has the following to say about mixing zones: "2. In the discharge of waste treatment plant effluent and cooling waters to the receiving waters, cognizance shall be given both in time and distance to allow for mixing of effluent and streams. Such distances required for complete mixing shall not affect the water usage Class adopted but shall be defined and controlled by the Commission."
Delaware	-Delaware makes the following references to mixing zones in item 3(b), General Water Quality Standards For Interstate Streams: "The standards proposed are based upon the ability of the Commission to measure and to determine compliance. All measurements will be made at selected after determining "representativeness" of the sample obtained and the nature of the mixing at the station."
District of Columbia	- "Criteria shall apply to an entire stretch of the stream. However, reasonable allowance shall be made for the mixing and dispersion of approved discharges. Sampling frequency shall provide a sound basis for computations. Within the limits of field condition, sampling point locations will be selected to permit the collection of representative samples." "There shall be.....No increase in natural water temperature caused by artificial heat inputs shall exceed 5 degrees F. after reasonable allowance for mixing."
Guam	No reference to mixing zones.

- Florida No reference to mixing zones.
- Hawaii -This class of waters is to be used as zones of mixing for the assimilation of municipal, agricultural and industrial discharges which have received the best practicable treatment or control or such lesser degree of treatment or control as will provide for a water quality commensurate with the classified use of the waters outside the zone of mixing. In addition to periodic reports on monitoring by dischargers, samples of receiving waters will be taken both within the designated zone of mixing and at the outer edges of the zone.
- Idaho No reference to mixing zones.
- Illinois -The discharge of heated liquids into interstate waters should be prescribed so as to prevent barriers to fish passage and minimize temperature increases inside and outside a reasonable mixing zone.
- Indiana No reference to mixing zones.
- Iowa -Sampling to determine conformance to these criteria shall be done at sufficient distances down stream from waste discharge points to permit adequate mixing...
- Georgia No reference to mixing zones.
- Kansas -The measurement system to be used in each case should provide for temperature measurement at the outfall and with the maximum temperature allowed at the outfall reflecting a reasonable mixing zone in the receiving waters so that the 5°F or 3°F rise specified is not violated in the contiguous waters. Any barrier to migration and the free movement of aquatic biota is prohibited.
- Kentucky -"...Further, the discharges into any of the main stems of the rivers under consideration is not based on a dilution as being the substitution for treatment. This Commission has utilized the concept that the zone of influence of a discharge must be maintained in satisfactory condition. In fact, waste treatment by industry and municipality have been required alike so that no adverse affect shall accrue in the zone of influence shall occur in any constituent in the rivers as a whole....."
- Louisiana No reference to mixing zones.

Maine

-After adoption of any classification by the Legislature for surface waters or tidal flats or sections thereof, it shall be unlawful for any person, corporation, municipality, or other legal entity to dispose of any sewage, industrial or other waste, either alone or in conjunction with another or others, in such manner as will, after due consideration for seasonal, climatic, tidal and natural variations and after reasonable opportunity for dilution, diffusion, mixture or heat transfer to the atmosphere, within mixing zones reasonably established by the commission in the manner provided by this section, lower the quality of said waters, outside such zones, below the minimum requirements of such classification and notwithstanding any licenses which may have been granted or issued under section 413 to 415.

The commission may establish a mixing zone with respect to any discharge at the time application for license for such discharge is made pursuant to section 414, and when so established shall be a condition of and form a part of the license issued. The commission may, after 30 days' notice to and a hearing with the affected party, establish by order a mixing zone with respect to any discharge for which a license has heretofore been issued pursuant to section 414, or for which no license is required by virtue of the last sentence of section 413. Prior to the issuance of any order, or commencement of any enforcement action to abate a classification violation, the commission shall establish, in the manner above provided, a mixing zone with respect to the discharge sought to be thereby affected.

In determining the extent of any mixing zone to be by it established under this section, the commission shall solicit and receive testimony concerning the nature and rate of the discharge; the nature and rate of existing discharges to the waterway and their effect upon the ability of the waterway to achieve its classification standards; the size of the waterway and the rate of flow therein; any seasonal, climatic, tidal and natural variation in such size, flow, nature and rate and the effect of such variation upon the ability of the waterway to achieve its classification standards; the uses of the waterways in the vicinity of the discharge, and such other and further evidence as in the commission's judgment will enable it to establish a reasonable mixing zone for such discharge. An order establishing a mixing zone may provide that the extent thereof shall vary in order to take into account seasonal, climatic, tidal and natural variations in the size and flow of, and the nature and rate of discharge to, the waterway.

Where no mixing zones have been established by the commission, it shall be unlawful for any person, corporation, municipality or other legal entity to dispose of any sewage, industrial or

other waste, either alone or in conjunction with another or others, into any classified surface waters, tidal flats or sections thereof, in such manner as will, after reasonable opportunity for dilution, diffusion, mixture or heat transfer to the atmosphere, lower the quality of any significant segment of said waters, tidal flats or sections thereof, affected by such discharge, below the minimum requirements of such classification, and notwithstanding any licenses which may have been granted or issued under section 413 to 415.

Maryland

- "For all water use categories other than IV, there must be no temperature change that adversely affects fish or other aquatic life, or spawning success. There must be no thermal barriers to the passage of fish or other aquatic life. Maximum temperature must not exceed 100 degrees F beyond 50 ft. from any point of discharge."

For NONTIDAL WATERS: "For the propagation of fish and other aquatic life (Water Use Category IV) in all other nontidal waters, temperature must not exceed 93 degrees F. beyond such distance from any point of discharge as specified by the Department as necessary for the protection of the water use."

For TIDAL WATERS: used for the propagation of fish and other aquatic life (Water Use Category IV), temperature must not exceed 90 degrees F. beyond such distance from any point of discharge as specified by the Department as necessary for the protection of the water use."

Massachusetts

- "When an effluent is permitted to be discharged to the receiving waters, cognizance shall be given both in time and distance to allow for mixing of effluent and stream. Such distances required for complete mixing shall not affect the water usage class adopted."

Michigan

No reference to mixing zones.

Minnesota

- The only thing relating to mixing zones is the following statement: "....Reasonable allowance will be made for dilution of the effluents in relation to the uses of the interstate waters into which they are discharged or other interstate waters which may be affected...."

Mississippi

- Temperature shall not be increased more than ten degrees F (10°F) above the natural prevailing background temperatures, nor exceed a maximum of 93°F after reasonable mixing.

Missouri

No reference to mixing zones.

Montana

No reference to mixing zones.

Nebraska

No reference to mixing zones.

Nevada

New Hampshire

-New Hampshire has adopted the criteria of the New England Interstate Water Pollution Control Commission with regard to temperature which states, "...A heated discharge to a lake shall not raise the temperature more than 3 degrees F at the surface immediately outside a designated mixing zone." New Hampshire had also adopted verbatim the entire criteria pertaining to temperature and zones of passage contained in Section 3 of the National Technical Advisory Committee Report on Water Quality Criteria dated April 1, 1968. This report makes recommendation regarding mixing zones and zones of passage on page 31.

New Jersey

-Localized areas of surface waters, as may be designated by the Department, into which wastewater effluents, including heat, may be discharged for the purpose of mixing, dispersing or dissipating such wastewater without creating nuisances or hazardous conditions.

Localized areas of surface waters, as may be designated by the Department, into which wastewater effluents including heat, may be discharged for the purpose of mixing, dispersing or dissipating such wastewater without creating nuisances or hazardous conditions.

Trout Maintenance Streams: No heat may be added which would cause temperatures to exceed 2°F over the natural temperatures at any time or which would cause temperatures in excess of 68°F. Reductions in temperatures may be permitted where it can be shown that trout will benefit without detriment to other designated water uses. The rate of temperature change in designated mixing zones shall not cause mortality of the biota.

Non-Trout Waters: No thermal alterations, except in designated mixing zones, which would cause temperatures to deviate more than 5°F at any time from natural stream temperatures of more than 3°F in the epilimnion of lakes and other standing waters. No heat may be added, except in designated mixing zones, which would cause temperatures to exceed 82°F for smallmouth bass or yellow perch waters or 86°F for other non-trout waters. The rate of temperature change in designated mixing zones shall not cause mortality of the biota.

New Mexico

-The following policy guideline statement concerns mixing zones: "...as samples taken for the regulation and enforcement of these standards are to be collected at the mid-point of the stream flow at locations a sufficient distance downstream

from the point of introduction of waste-water inflow to provide for reasonable mixing of the stream and the inflowing water. Sampling in reservoirs and lakes for the purposes of the general standards may be at any point in the body of the water, but not closer than 250 feet from the point of introduction of a water contaminant. A reservoir or lake is considered to include all of the area flooded when the water in the basin is at the spillway level.

New York

-Trout Maintenance Streams: No heat may be added which would cause temperature to exceed 2°F over the natural temperatures at any time or which would cause temperatures in excess of 68°F . Reductions in temperatures may be permitted where it can be shown that trout will benefit without detriment to other designated water uses. The rate of temperature change in designated mixing zones shall not cause mortality of the biota.

Non-Trout Waters: (1) Mixing Zone: The mixing zone will be separately determined for each discharge so as to minimize detrimental effects. Fish and other aquatic life shall be protected from thermal blocks by providing for a minimum fifty percent stream or estuarine cross-section and/or volumetric passageway, or establishing artificial fishways where considered necessary. Generally, the surface water temperature shall not exceed 90°F within the mixing zone. Consideration will be given to effects of each discharge based on hydrodynamics and other factors of receiving waters. (2) Outside Mixing Zone: Stream temperature in excess of 86°F will not be permitted after mixing. Further, no permanent change in excess of 5°F will be permitted from naturally occurring background temperatures. In multiple discharge situations stream capacity to meet such criteria will be apportioned among the discharges. (3) Outside Mixing Zone: Fresh Surface Water Classes: Temperature change rate shall be limited to 2°F per hour, not to exceed 9°F in any 24-hour period, further limited in that for any seven day period the average change will meet the 5°F change of background criteria stated in item 2 above. (4) Outside Mixing Zone: Tidal Salt Water Classes: Discharges shall not raise monthly means of maximum daily temperatures more than 4°F from September through May, nor more than 1.5°F during June, July, and August. Temperature change shall not be more than 1°F per hour, not to exceed 7°F in any 24-hour period at maximum, except when natural phenomena cause these limits to be exceeded.

North Carolina

-In making tests or analytical determinations of classified waters to determine conformity or nonconformity with the established standards, samples shall be collected beyond the boundaries of prescribed mixing zones in such manner and at such times and locations as to be representative of the receiving waters after reasonable opportunity for dilution and mixture with the wastes discharged thereto. The boundaries of such mixing zones will be determined for each waste discharge after consideration of the magnitude and character of the discharge, the size and character of the receiving stream or waters in question, and shall be restricted to as small an area and length as possible. In streams or other waters which support fish, a free passage-way of at least 75% of the cross-sectional area and/or volume of flow shall be free of any barriers to and shall be maintained for the migration and free movement of fish, drift organisms, and other resident species of aquatic life. In free-flowing waters, the passageway shall extend for a considerable distance along the same bank. In marine waters, lakes, ponds, and reservoirs, a passage-way shall be provided between the shore and the zone influenced by the discharged wastewaters.

North Dakota

-"The distance of river flow to allow for a reasonable opportunity to mix and dilute wastes shall be at the discretion of the State Department of Health and will be based upon stream flow conditions at the time of sampling, except where such discharges may adversely affect a beneficial water use immediately downstream or in close proximity to the waste point. In such instances, a change in the method of waste discharge or other control measures may be required."

Ohio

No reference to mixing zones.

Oklahoma

No reference to mixing zones.

Oregon

No reference to mixing zones.

Pennsylvania

No reference to mixing zones.

Puerto Rico

No reference to mixing zones.

Rhode Island

-The following statement on mixing zones is made under the heading of "General Policy." In the discharge of waste treatment plant effluents to the receiving waters, cognizance shall be given both in time and distance to allow for mixing of effluent and stream. Such distances required for complete mixing shall not affect the water usage Class adopted but shall be defined and controlled by the regulatory authority."

South Carolina	-Not to exceed 93.2 degrees F at any time, after adequate mixing of heated and normal water, as the result of the discharge of heated liquids, nor shall the water temperature in a zone of adequate mixing be more than 10 degrees F greater than that of water unaffected by the heated discharge. PROVIDED: That hydraulic conditions at the point of discharge are arranged so that there is an unheated zone for fish passage between the point of discharge and the zone of adequate mixing."
South Dakota	-The following statement on mixing zones is concerned with sampling procedures under Section III - <u>Enforcement Provisions</u> : " 4. In making tests or analytical determinations of surface waters to determine conformity or non-conformity with the established criteria, samples shall be collected in such manner and at such locations, times and frequencies as approved by the Committee. Every effort should be made to make the samples representative of the receiving waters after reasonable opportunity for dilution and mixture with the polluting material discharged thereto."
Tennessee	-Mixing zone refers to that section of flowing stream or impounded waters necessary for effluents to become dispersed. The Mixing zone necessary in each particular case shall be defined by the Tennessee Stream Pollution Control Board.
Texas	-"3. Sampling will be in accordance with fully recognized procedures. Samples must be representative of the receiving waters allowing time and distance for mixing."
Utah	No reference to mixing zones.
Vermont	-"In assigning classifications to the waters of the State the department may designate certain lengths or areas of such waters as mixing zones provided that any such mixing zones shall be only for the dispersal and dilution of wastes which have been treated in a manner approved by the department, shall be of no greater length or area than is required for such purposes and may only be allowed if such wastes conform substantially with the technical and other requirements established for the receiving waters. Such a mixing zone shall not constitute a barrier to the passage or migration of fish or produce adverse effects on any fishery or other forms of wild or aquatic life."
Virgin Islands	No reference to mixing zones.
Virginia	No reference to mixing zones.
Washington	No reference to mixing zones.
West Virginia	No reference to mixing zones.

Wisconsin

-No reference to mixing zones.

Wyoming

-No reference to mixing zones.